

CLAIMS

1 **1.** A test system for testing an in-test host's support of USB peripherals,
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3 the test system comprising:

4 one or more USB interfaces configured to communicate with one or more
5 USB ports of the in-test host to communicate USB messages with the in-test host;

6 a network interface configured to communicate with a peripheral emulator
7 using a network communications protocol;

8 operating logic configured to perform actions comprising:

9 receiving USB command messages from the in-test host;

10 sending the received USB command messages to the
11 peripheral emulator through the network interface using the network
12 communications protocol; and

13 receiving USB response messages from the peripheral
14 emulator through the network interface using the network
15 communications protocol;

16 sending the received USB response messages through the one
17 or more USB interfaces to the in-test host.

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19 **2.** A test system as recited in claim 1, further comprising the peripheral
20 emulator, wherein the peripheral emulator is programmed to emulate one or more
21 USB peripherals.
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1 3. A test system as recited in claim 1, further comprising the peripheral
2 emulator, wherein the peripheral emulator is programmed to emulate HID, bulk,
3 and isochronous USB peripherals.

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5 4. A test system as recited in claim 1, further comprising the peripheral
6 emulator, wherein the peripheral emulator comprises a general-purpose computer
7 programmed to emulate one or more USB peripherals.

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9 5. A test system as recited in claim 1, further comprising the peripheral
10 emulator, wherein the peripheral emulator comprises a general-purpose computer
11 programmed to emulate HID, bulk, and isochronous USB peripherals.

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13 6. A test system as recited in claim 1, further comprising the peripheral
14 emulator, wherein:

15 the peripheral emulator comprises a general-purpose computer;

16 the general-purpose computer is programmed to emulate one or more USB
17 peripherals; and

18 the general-purpose computer is further programmed to generate USB
19 response messages that test the in-test host with ranges of USB peripheral
20 parameters.

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22 7. A test system as recited in claim 1, further comprising the peripheral
23 emulator, wherein:

24 the peripheral emulator comprises a general-purpose computer;

1 the general-purpose computer is programmed to emulate one or more USB
2 peripherals; and

3 the general-purpose computer is further programmed to generate abnormal
4 USB response messages in order to test the in-test host with such abnormal USB
5 response messages.

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7 **8.** A test system as recited in claim 1, wherein:

8 a particular USB command message is designated for a particular one of a
9 plurality of different emulated peripheral devices;

10 the network communications protocol supports a plurality of logical ports;

11 the operating logic maintains a correspondence between emulated
12 peripheral devices and logical ports; and

13 the operating logic sends said particular USB command message to one of
14 the logical ports that corresponds to said particular one of the plurality of different
15 emulated peripheral devices.

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17 **9.** A test system as recited in claim 1, wherein the one or more USB
18 interfaces comprise at least four USB interfaces.

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20 **10.** A test system as recited in claim 1, wherein the USB messages
21 comprise HID, bulk, and isochronous USB messages.

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23 **11.** A test system as recited in claim 1, wherein the network interface
24 comprises an Ethernet interface.

1 **12.** A test system as recited in claim 1, wherein the network
2 communications protocol comprises an Ethernet communications protocol.

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4 **13.** A test system as recited in claim 1, wherein the network
5 communications protocol comprises an IP protocol.

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7 **14.** A test system as recited in claim 1, wherein the network
8 communications protocol comprises UDP over IP.

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10 **15.** A test system for testing an in-test host's support of peripheral
11 devices that utilize a peripheral communications protocol, the test system
12 comprising:

13 a peripheral interface configured to communicate with a peripheral device
14 port of the in-test host using the peripheral communications protocol;

15 a network interface configured to communicate with a peripheral emulator
16 using a network communications protocol;

17 operating logic configured to perform actions comprising:

18 receiving outgoing peripheral device messages through the
19 peripheral interface from the in-test host using the peripheral
20 communications protocol;

21 sending the received outgoing peripheral device messages
22 through the network interface to the peripheral emulator using the
23 network communications protocol;

1 receiving incoming peripheral device messages through the
2 network interface from the peripheral emulator using the network
3 communications protocol; and

4 sending the received incoming peripheral device messages
5 through the peripheral interface to the in-test host using the
6 peripheral communications protocol.

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8 **16.** A test system as recited in claim 15, further comprising the
9 peripheral emulator, wherein the peripheral emulator is programmed to emulate
10 one or more USB peripherals.
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12 **17.** A test system as recited in claim 15, further comprising the
13 peripheral emulator, wherein the peripheral emulator comprises a general-purpose
14 computer programmed to emulate one or more USB peripherals.
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16 **18.** A test system as recited in claim 15, further comprising the
17 peripheral emulator, wherein the peripheral emulator comprises a general-purpose
18 computer programmed to emulate one or more USB peripherals and to generate
19 peripheral device messages that test the response of the in-test host to ranges of
20 USB peripheral parameters.
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1 **19.** A test system as recited in claim 15, further comprising the
2 peripheral emulator, wherein the peripheral emulator comprises a general-purpose
3 computer programmed to emulate one or more USB peripherals and to generate
4 peripheral device messages that test the response of the in-test host to abnormal
5 conditions.

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7 **20.** A test system as recited in claim 15, wherein:
8 a particular outgoing peripheral device message is designated for a
9 particular one of a plurality of different emulated peripheral devices;
10 the network communications protocol supports a plurality of logical ports;
11 the operating logic sends said particular outgoing peripheral device
12 message to one of the logical ports that corresponds to said particular one of the
13 plurality of different emulated peripheral devices.

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15 **21.** A test system as recited in claim 15, wherein the peripheral interface
16 comprises a USB interface.

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18 **22.** A test system as recited in claim 15, wherein the received outgoing
19 peripheral device messages comprise USB messages and the received incoming
20 peripheral device messages are sent to the in-test host as USB messages.

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22 **23.** A test system as recited in claim 15, wherein the peripheral
23 communications protocol conforms to the USB standard.
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1 **24.** A test system as recited in claim 15, wherein the network interface
2 comprises an Ethernet interface.

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4 **25.** A test system as recited in claim 15, wherein the network
5 communications protocol comprises an Ethernet communications protocol.

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7 **26.** A test system as recited in claim 15, wherein the network
8 communications protocol comprises an IP protocol.

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10 **27.** A test system as recited in claim 15, wherein the network
11 communications protocol comprises UDP over IP.

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13 **28.** A method of testing an in-test host's support of USB peripherals,
14 comprising:

15 receiving USB command messages from the in-test host;

16 packaging the received USB command messages in command data packets
17 formatted in accordance with a network communications protocol;

18 sending the command data packets to one or more peripheral emulators
19 over network communications media;

20 receiving response data packets from the one or more peripheral emulators
21 over the network communications media, wherein the response data packets are
22 formatted in accordance with a network communications protocol;

23 unpackaging USB response messages from the received response data
24 packets;

25 sending the unpackaged, USB response messages to the in-test host.

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2 **29.** A method as recited in claim 28, further comprising emulating one
3 or more different USB peripherals within the one or more peripheral emulators to
4 create the incoming USB messages.

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6 **30.** A method as recited in claim 28, further comprising creating
7 abnormal USB response messages in response to the packaged USB command
8 messages and packaging said abnormal USB response messages in the response
9 data packets in order to test the in-test host's ability to handle such abnormal USB
10 response messages.

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12 **31.** A method as recited in claim 28, wherein the network
13 communications protocol comprises an Ethernet communications protocol.

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15 **32.** A method as recited in claim 28, wherein the network
16 communications protocol comprises an IP protocol.

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18 **33.** A method as recited in claim 28, wherein the network
19 communications protocol comprises UDP over IP.

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21 **34.** A computer comprising:
22 a network interface configured to receive network communications
23 formatted in accordance with a network communications protocol;
24 one or more processors programmed to perform actions comprising:
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1 emulating one or more USB peripherals in order to create
2 USB response messages;

3 packaging the USB response messages in response data
4 packets formatted in accordance with the network communications
5 protocol; and

6 sending the response data packets over network
7 communications media.

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9 **35.** A computer as recited in claim 34, wherein the one or more
10 processors are programmed to perform further actions comprising:

11 receiving data packets over the network communications media, wherein
12 the data packets are formatted in accordance with a non-USB network
13 communications protocol; and

14 unpackaging the USB response messages from the data packets.

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16 **36.** A computer as recited in claim 34, wherein the one or more
17 processors are programmed to emulate HID, bulk, and isochronous USB
18 peripherals.

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20 **37.** A computer as recited in claim 34, wherein the network
21 communications protocol comprises an Ethernet communications protocol.

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23 **38.** A computer as recited in claim 34, wherein the network
24 communications protocol comprises an IP protocol.
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1 **39.** A computer as recited in claim 34, wherein the network
2 communications protocol comprises UDP over IP.

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4 **40.** One or more computer-readable media comprising instructions that
5 are executable to perform actions comprising:

6 emulating one or more USB peripherals that respond to and create USB
7 messages;

8 packaging the created USB messages in data packets formatted in
9 accordance with a non-USB network communications protocol;

10 sending the data packets over network communications media using the
11 network communications protocol.

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13 **41.** One or more computer-readable media as recited in claim 40,
14 wherein the instructions are executable to perform further actions comprising:

15 receiving data packets over the network communications media, wherein
16 the data packets are formatted in accordance with a non-USB network
17 communications protocol; and

18 unpackaging the USB messages from the data packets.

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20 **42.** One or more computer-readable media as recited in claim 40, said
21 wherein said emulating comprises emulating HID, bulk, and isochronous USB
22 peripherals.

1 **43.** One or more computer-readable media as recited in claim 40,
2 wherein the network communications protocol comprises an Ethernet
3 communications protocol.

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5 **44.** One or more computer-readable media as recited in claim 40,
6 wherein the network communications protocol comprises an IP protocol.

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8 **45.** One or more computer-readable media as recited in claim 40,
9 wherein the network communications protocol comprises UDP over IP.
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